

ABSTRACT

A piezoelectric quartz plate having reduced frequency deviation as a function of temperature, wherein the quartz plate is cut at an angle described by:

$$T_f = 3.9 + 6.5 \cos^2 \theta + \frac{1}{2} \left[\frac{c_{66} T_{c_{66}} \sin^2 \theta + c_{44} T_{c_{44}} \cos^2 \theta + T_{c_{14}} c_{14} \sin 2\theta}{c_{66} \sin^2 \theta + c_{44} \cos^2 \theta + c_{14} \sin 2\theta} \right] +$$

$$\left[a' \cdot \left(\sin(\omega \cdot \theta + \phi') + \sin(\omega \cdot \theta + \phi')^2 \right) \right] + \delta$$

where quartz plate thickness is chosen in accordance with a desired frequency. This useful behavior can be manipulated such that a quartz plate is designed to counteract frequency shifts over temperature excursion of other electrical components found in typical oscillator circuits.

The choice of angles of cut having larger margins of error means that quartz oscillators can be more easily reproduced on a large scale and at a lower cost than has traditionally been the case.